

WHAT IS CLAIMED IS:

1 1. A defect inspection apparatus comprising:
2 a mount for mounting a specimen;
3 an illumination light to illuminate the specimen;
4 an imaging optical system forming an image of the specimen, the
5 imaging optical system including an objective lens with a numerical aperture providing a
6 resolution of at least 0.18 microns, when combined with the illumination light;
7 an opto-electrical converter positioned to detect the image of the
8 specimen;
9 an auto-focus optical system including an illumination module and a
10 detection module, the illumination module providing illumination on a surface of the
11 specimen at an incident angle of at least 85 degrees relative to a normal of a surface of the
12 specimen, the detecting module detecting light from the illumination module and reflected by
13 the specimen;
14 an adjuster for adjusting a focal position of the imaging optical system
15 based on a detection signal received from the auto-focus optical system; and
16 a detector which detects defects on the specimen by processing
17 electronic signals from the opto-electrical converter.

1 2. Apparatus in claim 1 further comprising:
2 a temperature detector to measure temperature of the imaging optical
3 system; and
4 a controller to control the adjuster using temperature information
5 detected by the temperature detector.

1 3. Apparatus in claim 2 wherein the temperature detector measures a
2 temperature at or near the objective lens of the imaging optical system.

1 4. Apparatus in claim 2 wherein the controller predicts a focal position
2 offset based on temperature information detected by the temperature detector and a
3 previously estimated relationship between temperature and focal position offset and uses the
4 predicted focal position offset to control the adjuster based on the prediction.

1 5. A defect inspection apparatus comprising:
2 means for mounting a specimen;
3 means for illuminating the specimen;
4 an imaging optical system forming an optical image of said illuminated
5 specimen;
6 means for opto-electrical conversion detecting an optical image of said
7 specimen formed by said imaging optical system;
8 an auto-focus optical system diagonally illuminating a surface of said
9 specimen and detecting light reflected from said specimen;
10 means for measuring temperature of said imaging optical system;
11 means for adjusting a focal position of said imaging optical system
12 based on a detection signal from said auto-focus optical system and information about a
13 temperature of said imaging optical system measured by said temperature measuring means;
14 means for detecting defects on said specimen by processing electronic
15 signals output from said opto-electrical converting means; and
16 means for displaying, on a screen, information relating to defects of
17 said specimen detected by said defect detecting means.

1 6. A defect inspection apparatus as in claim 5 wherein said imaging
2 optical system includes an objective lens with a numerical aperture providing a resolution of
3 at least 0.18 microns, when combined with said illumination light from said illuminating
4 means.

1 7. A defect inspection apparatus as in claim 5 wherein said auto-focus
2 optical system provides illumination on a surface of said specimen mounted on said mounting
3 means at an incident angle of at least 85 degrees relative to a normal of said specimen
4 surface.

1 8. A method for inspecting defects comprising the following steps:
2 illuminating a surface of a specimen at an angle relative to said
3 surface;
4 detecting light from said illumination reflected by said specimen;
5 determining, based on a signal obtained by detecting light reflected
6 from said specimen, a focal position of an imaging optical system used to form an optical
7 image of a surface of said substrate;
8 matching a height position of said specimen with said determined focal
9 position;
10 illuminating said specimen at said matched height;
11 forming an optical image of said specimen using said imaging optical
12 system equipped with an objective lens with a numerical aperture providing a resolution of at
13 least 0.18 microns, when combined with said illumination light from said illuminating means;
14 capturing an optical image of said specimen; and
15 processing a signal obtained by capturing said optical image of said
16 specimen and detecting defects of said specimen.

1 9. A method for inspecting defects on a specimen as in claim 9 further
2 comprising the following steps:
3 measuring a temperature of said imaging optical system; and
4 determining a focal position of said imaging optical system using said
5 measured imaging optical system temperature information.

10. A method for inspecting defects on a specimen as in claim 8 wherein temperature at or near said objective lens of said imaging optical system is measured.

11. A method for inspecting defects on a specimen as in claim 8 wherein:
a focal position offset is predicted based on temperature information detected by said temperature detecting means and previously determined relationship between temperature and focal position offset; and
a focal position of said imaging optical system is controlled based on said prediction.

12. A method for inspecting defects comprising the following steps:
illuminating a surface of a specimen at an angle relative to said surface;
detecting light from said illumination reflected by said specimen;
measuring a temperature of an imaging optical system which has an objective lens;
detecting light reflected from said surface of said specimen and determining, based on an obtained signal and said measured temperature information, a focal position of an imaging optical system;
matching a height of said specimen with said determined focal position;
illuminating said specimen at said matched height;
forming an optical image of said specimen illuminated by said illumination light using said imaging optical system;
capturing an optical image of said specimen; and
processing a signal obtained by capturing said optical image of said specimen and detecting defects of said specimen.

1 13. A method for inspecting defects as in claim 12 wherein a temperature
2 of said objective lens is measured in said step for measuring a temperature of said imaging
3 optical system.

1 14. A method for inspecting defects as in claim 12 wherein said objective
2 lens has a numerical aperture providing a resolution of at least 0.18 microns, when combined
3 with said illumination light from said illuminating means, and said optical image is formed
4 via said objective lens.

1 15. A method for inspecting defects as in claim 12 wherein said light
2 illuminating said surface of said specimen at an angle relative to said surface is illuminated
3 with an incident angle of at least 85 degrees relative to a normal of said specimen surface.

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